Allen-Bradley

PHOTOSWITCH®
Photoelectric Sensors
ColorSight Series 9000
User Manual

UL® c UL® C€
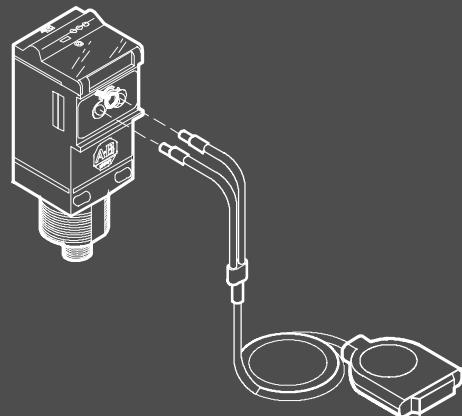
Introduction

This manual explains how to install, adjust, and program ColorSight Series 9000 photoelectric sensors

Rockwell Automation

Table of Contents

General Specifications

|		
Cat No.	2m cable	42QA-G5LE-A2
	5-pin DC micro	42QA-G5LE-D5
	5-pin DC mini	42QA-G5LE-N5
Optical	Sensing Mode	Fixed Focus
	Sensing Distance	27mm (with A-B #60-2694 fiber optic cable)
	Spot Size	5mm (with A-B # 60-2694 fiber optic cable) nominal
	Transmitting LED	Tri-color red, green, blue
	Color Discrimination Operating Mode	Color only, color plus intensity (selectable via dip-switch)
	Precision Adjustment	8 position rotary switch
	Color Sampling Operating Mode	Single, Average (selectable via dipswitch)
Electrical	Supply Voltage	10 to 30V DC
	Current Consumption	50mA nominal
	Response Time	(single mode) 1.3ms; (average mode) 10ms (C + I mode) (single mode) 2.6ms; (average mode) 10ms (C only)
	Protection	False pulse, reverse polarity on all leads, output short-circuit protected (100mA), transient/burst
	Output Type (Sensor and Diagnostic)	Transistor
	Output Load Voltage/Current (Sensor and Diagnostic)	30V DC, 100mA
	Sensor Output Energized	Match/No match-operate (selectable via DIP switch)
	Diagnostic Output Energized	Normal operation, i.e., successful learn
Mechanical	Housing Material	Valox®
	Housing Cover Material	Radel R5000
	Indicators	See table on page 6
Environmental	HF ambient light rejection	25 foot candles
	Incandescent light rejection	500 foot candles
	Operating Temperature	0°C to +55°C (32°F to +131°F)
	Temperature Drift	+/-10°C from learned temperature
	Operating Environment	Sensor body: NEMA 4 IP54; Optics assembly: IP40
	Vibration	10-55Hz, 1mm amplitude, Meets or exceeds IEC 60947-5-2
	Shock	30G with 1ms pulse duration, Meets or exceeds IEC 60947-5-2
	Relative Humidity	Up to 95% noncondensing
	Approvals	UL, cUL ,CE (applied for) marked for all applicable directives

Summary of ColorSight Features

- Single color detection with adjustable precision settings
- Local and remote self teach operation
- Color only and color plus intensity operating modes
- Single and averaging sampling rates
- Selectable gating input
- Fixed selectable OFF delay
- Output SCP
- Reversible supply leads for Source or Sink (PNP or NPN) operation
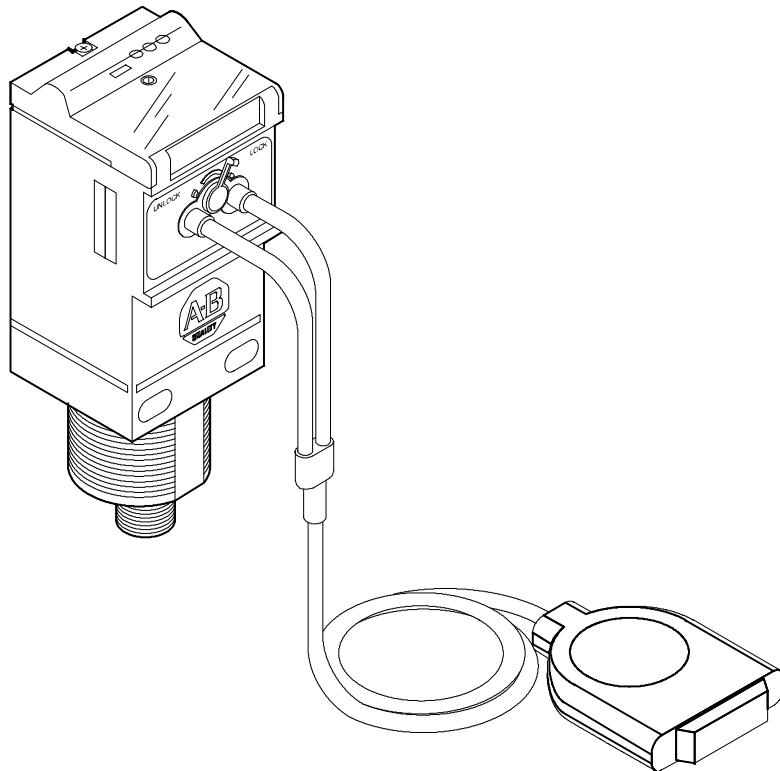
User Interface

Using an instrument screwdriver, open the top cover of the sensor to gain access to the user interface panel. This panel contains a pushbutton, 8-turn knob, 6 dip-switches, and LED indicators for configuring and viewing the sensor's operation and status. A more complete description of each item is described below.
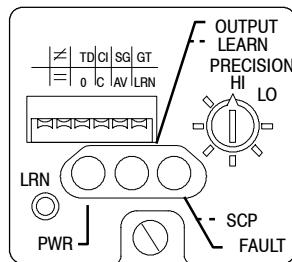
Pushbutton

A single momentary pushbutton, labeled LRN, is used to "teach" the sensor the color of the target being sensed. With the target in place, momentarily depress this pushbutton. The yellow LED will flash indicating that the sensor is "learning" the target. With the release of the pushbutton, the yellow and red LED will turn OFF indicating a successful learn. If the yellow LED turns OFF, but the red LED turns ON then the learn was unsuccessful.

8 Turn Knob

Labeled PRECISION, an 8 position knob is provided to select the desired level of precision for color discrimination. Turning the knob toward HI provides the highest level of color discrimination, with lessening degrees approaching LO.

Dip-Switches

A bank of 6 dip-switches are provided for configuring various operating modes and parameters available with ColorSight. These are defined in the table below and explained in further detail in the Configuration section on page 10.

Switch	Label	Function	Switch Up	Switch Down
S1	None	Not used	—	—
S2	≠ / =	Select target match/no match	Output inactive	Output active ❶
S3	TD/0	Enable/disable time delay	50ms time delay active	No time delay ❶
S4	CI/C	Select color + intensity mode/color only mode	Color + intensity mode active ❶	Color only mode active
S5	SG/AV	Select single/average mode	Single sample mode active	Average sample mode active ❶
S6	GT/LRN	Select gate/remote learn mode	Input functions as gating input	Input functions as remote learn ❶

❶ Factory default

Indicators

Three LED indicators are provided to indicate a variety of conditions making it easy for installation and troubleshooting. The function of each is described in the table below.

Label	Color	State	Condition
PWR	Green	OFF	Sensor power not present
		Steady	Sensor power present
OUTPUT/LEARN	Yellow	OFF	Output inactive
		Steady	Output active
		Flash	Learn mode activated
FAULT/SCP	Red	OFF	Sensor operating normally ❷
		Steady	Marginal detection of target ❸
		Flash	Output SCP active

❷ LED also OFF when LEARN pushbutton depressed.

❸ Includes failure to learn color during LEARN process.

Mounting the Sensor

Securely mount the sensor on a firm, stable, surface or support using one of the many mounting brackets available from Allen-Bradley. The sensor is supplied with hardware kit #129--130 which contains a plastic mounting nut, lock washer, 2 M5 x 0.8 x 53 screws and nuts.


M5 x 0.8 x 53
Combination
Screws and Nuts
(Supplied)

Hardware Kit
(Supplied)
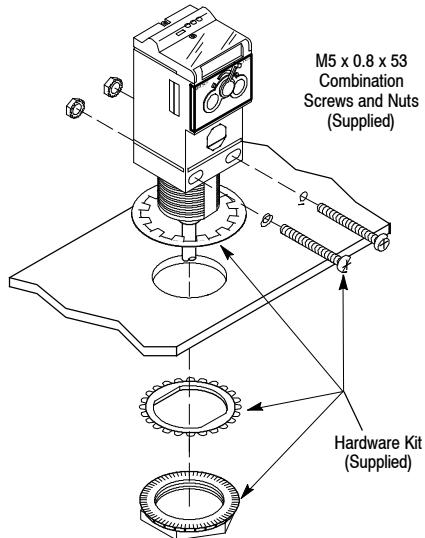
Optional Swivel/Tilt Bracket A--B #60--2439

1.100
(27.94)

1.150
(29.21)

1.125
(28.6)

0.500
(12.7)

2.0
(50.8)

2.6
(66.04)
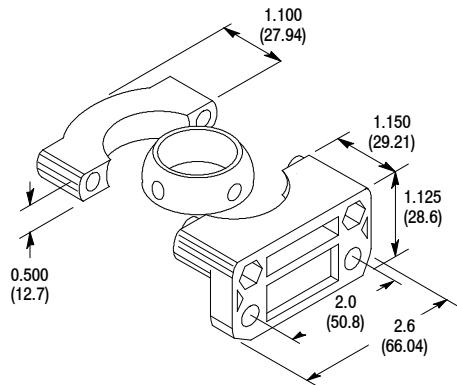
Installing the Fiber Optic Cables

ColorSight has been optimized to work with the Allen-Bradley #60–2694 Fiber Optic Assembly. Other cables may be used also, but with a possible reduction in performance.

Ensure that the fiber optic cable is installed with the emitter end in the source side of the sensor (left entry when viewed from the sensor front face) and the receiver end in the receive side of the sensor. The emitter portion is identified in blue. Care should be taken to ensure that the fiber optic cavity and fiber optic cables are securely seated.

UNLOCK

1. Set lever to UNLOCK position.   2. Insert fibers.

LOCK

3. Rotate lever to LOCK position.
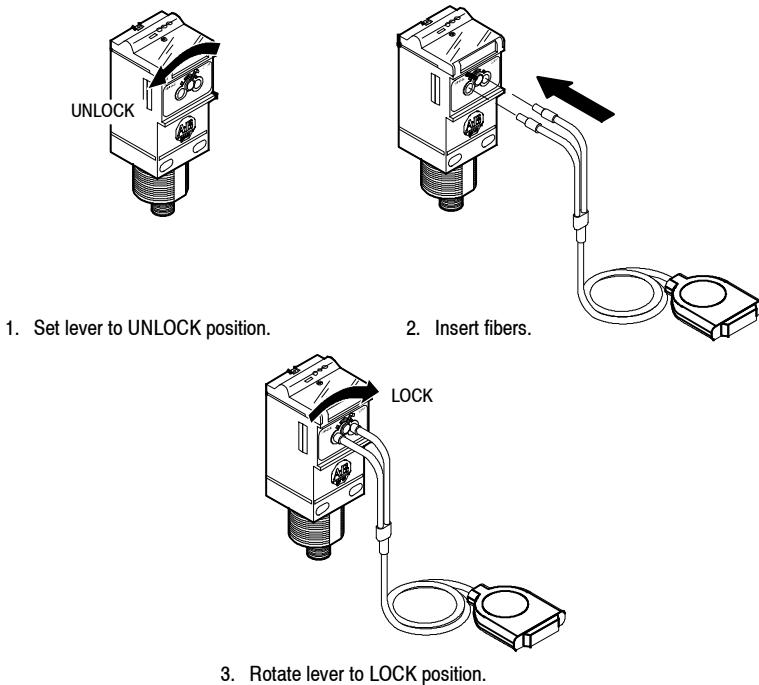
> **Damage to fiber optic cable may occur if inserted and removed with lever in locked position. Always grip by plastic tips, not cable sheathing.**

Aligning the Fiber Optic Cable Head (A-B #60-2694)

The head assembly should be positioned and securely fastened so that the lens is 27mm (1 1/16in) from the target to be sensed. When operating the sensor in COLOR ONLY mode this tolerance should not exceed +/- 3mm (1/8in). For high precision color discrimination applications using the COLOR PLUS INTENSITY mode, the tolerance can be no more than +/- 0.75mm (1/32in).
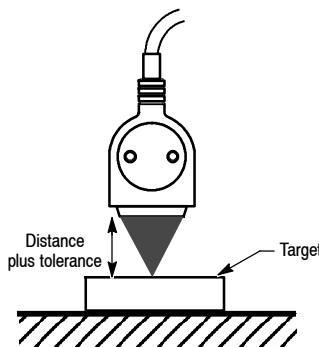
Wiring the Sensor

Models of ColorSight are available in one of three different connection types as identified in the following table. Allen-Bradley recommends the use of the 889 Series of cordsets and patchcords on the quick-disconnect models. All external wiring should conform to the National Electric Code and all applicable local codes.

| Designation	Lead Color	Pin Assignment	
	2m Cable	5-pin Micro QD	5-pin Mini QD
V+ or V- ❶	Brown	1	4
V- or V+ ❶	Blue	3	2
Signal output ❷	Black	4	1
Fault output ❷	Orange	5	3
Learn/Gate input ❷❸	White	2	5

❶ Polarity of supply voltage defines sensor output type –i.e. PNP or NPN

❷ PNP when brown lead connected to V+ and blue lead connected to V-

   NPN when brown lead connected to V- and blue lead connected to V+

❸ Function determined by selector switch S6

Wiring Diagrams

**Cable version wired with PNP outputs**
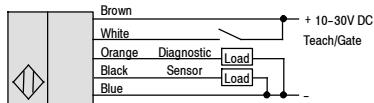
Cable version wired with NPN outputs
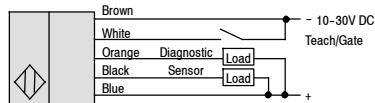
**Micro QD wired with PNP outputs**
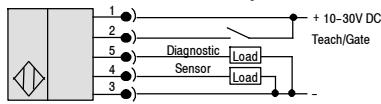
Micro QD wired with NPN outputs
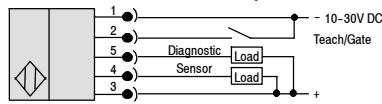
Mini QD wired with PNP outputs
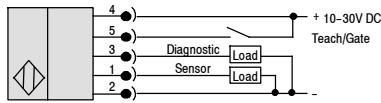
Mini QD wired with NPN outputs
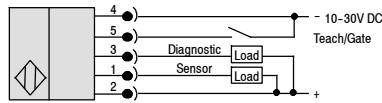
Configuring the Sensor

ColorSight can be configured to meet a wide variety of industrial applications. Various levels of coarse and fine color discrimination can be selected along with time delay, gating input, and remote learn options. Before initial use, it will be necessary to configure the sensor for the application at hand.

Using the table on page 6 as a reference, set the dip-switches on the user interface to define the following operating parameters.

1. Set the output operation, S2

   The sensor output may be activated upon either a match or no match color condition. The principal is the same as a light or dark operate condition in monochrome photoelectric sensors. The factory default setting of dip switch S2 is (=) which activates the output upon a color match condition. Move this switch to (≠) for the opposite effect.

2. Set the time delay, S3

   In some high speed applications it may be desirable to "stretch" the output signal to support slower PLCs. For this reason, ColorSight provides the option of selecting a 50ms time delay. This delay may be activated by moving dip-switch S3 to the (TD) position. The factory default setting is (0).

3. Set the color match operating mode, S4

   Not all applications will require the same level of color discrimination. Therefore, ColorSight offers two distinctly different modes of operation:

   1. Color Only: which measures proportions of the RGB values, and

2. Color Plus Intensity which measures the absolute RGB values.

The selection of one of these modes is made by toggling dip switch S4. For most applications, the Color Only mode will be suitable. When minute changes in target color must be recognized the Color Plus Intensity mode should be used.

4. Set the sampling rate, S5

ColorSight can be configured to operate at one of two fixed sampling rates. The factory default setting is (AV), or, averaging mode. In this mode the sensor will take multiple samples of the target and average the results for further processing. This type of operation is ideal for textured targets such as lumber and fabric. For smooth targets such as plastic, metal, or glass, selection of the (SG), or single sample, operating mode will yield acceptable results.

5. Set gating or remote learn operation, S6

A fifth lead (white) is provided on the sensor for use as either a gating input or remote learn input. The function of this lead is determined by the position of dip-switch S6. The factory default setting for S6 is LRN which will set this function for remote learn. In this mode, the sensor's self-teach will be activated whenever a momentary (at least 120ms) signal is applied to this lead. Acknowledgement of a successful learn, will be indicated by an active output on the orange fault lead. This lead may be tied to a PLC or pilot light for visual indication. In the event that the learn was not successful, this output will be inactive.

With dip-switch S6 in the (GT) position, the white lead will serve as a gating input. In this mode, the sensor output will be enabled only when this input is active (logical AND).

6. Congratulations, the sensor is now ready to learn the target color.

7. Apply power to the sensor.

8. Position the target 27mm from and perpendicular to the fiber optic head. Ensure that the target color fill the entire spot size provided by the sensor.

9. For local self–teach operation follow step 10, otherwise, follow step 11.

10. Momentarily depress the LRN pushbutton. The yellow LED will flash indicating that the sensor is "learning" the target. With the pushbutton released, the yellow and red LED will turn OFF indicating a successful learn. If the yellow LED turns OFF, but the red LED turns ON then the learn was unsuccessful.

11. Applying a momentary (at least 120ms) signal of to the white lead of the sensor has the same effect as depressing the LRN pushbutton. Acknowledgement of a successful learn will be indicated both locally and via the orange diagnostic lead. Note that the fault output remains active with the exception of an unsuccessful learn and during the learn process.

12. Sequence the target in and out of the sensors field of view to ensure proper color discrimination. It may be necessary to adjust the 8-turn knob to a higher setting to provide a higher degree of color discrimination.

13. Congratulations! The sensor has successfully learned the target.

Dimensions—inches (mm)

2.190
(55.62)

74.93
(2.950) Ref

M30 X 1.5
External Thread
1/2″ NPSM
Internal Thread

40.00
(1.575)

40
(1.58)

24.64
(0.970)

30.35
(1.195)

41.91
(1.650)

Mounting Hole
Centerline
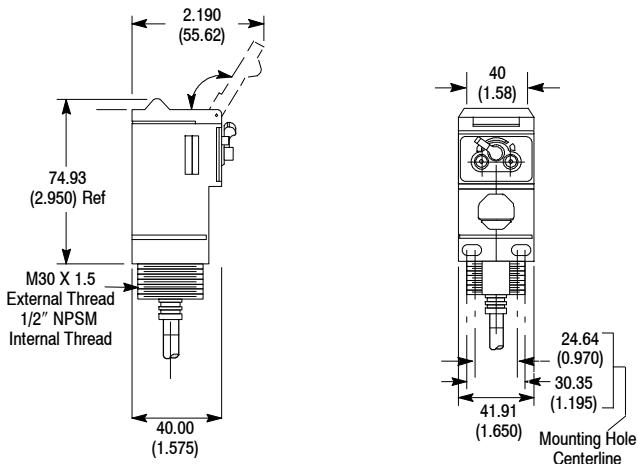
Connector Version

Micro Style

Mini Style

13.97 (0.550)

17.78 (0.700)
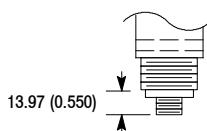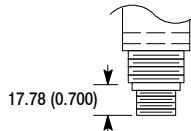
Thread Size

	DC
Micro Style	M12 x 1 1 Keyway
Mini Style	7/8–16 UN 1 Keyway

Accessories

Description	Catalog Number	
1.8m (6ft) mini QD Cordset	**889N-F5AF-6F**	
2m (6.5ft) micro QD Cordset	**889D-F5AC-2**	
Swivel/Tilt Bracket	**60-2439**	
360° Rotation Mounting Bracket	**60-2513**	
Universal Mounting Assembly	**60-2421**	
Universal Mounting Assembly (for Fiber Optic cable)	**60-2008**	
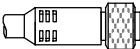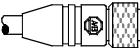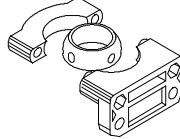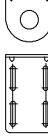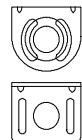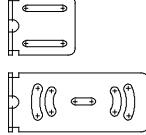
Terms and Definitions

Average Mode

A mode of operation, which takes multiple samples of the target being sensed. A typical application using this mode would be the color discrimination of textured materials such as textiles and lumber.

Color Only Mode

A mode of operation found in some color recognition sensors in which the target color is determined by measuring the hue and chroma attributes only. This type of mode is ideal when there is a large contrast between the targets being sensed. An example being, the discrimination of yellow versus red caps in a bottling application.

Color Plus Intensity

A mode of operation found in some color recognition sensors in which the target color is determined by measuring the absolute RGB values (hue, value, chroma). This type of mode is intended for applications where very high precision levels of color discrimination are required. An example is the discrimination of close shades of red.

NPN

A solid state output type for low voltage DC sensors with a sinking output. The load is connected between the (+) power connection and the sensor output. Low leakage currents, fast response times, and high switching currents are typical characteristics of this output type.

OFF Delay

A type of time delay which will delay the operation of the output for a set period of time after the target being sensed is no longer detected. An OFF time delay is typically used to "stretch" the output signal to provide ample scanning time for slower PLCs.

PNP

A solid state output type for low voltage DC sensors with a sourcing output. The load is connected between the sensor output and the (–) power connection. Low leakage currents, fast response times, and high switching currents are typical characteristics of this output type.

Single Mode

A mode of operation, which takes only single sample of the target being sensed. This mode of operation is suited for color discrimination on flat or untextured surfaces.

Troubleshooting

Green LED does not illuminate	Ensure power is connected to the sensor.
Target cannot be learned	Ensure fiber optic cables are securely seated in sensor cavity.
	Ensure emitter (blue) side of fiber optic cable is inserted in the emitter cavity (blue).
	Ensure the fiber optic head is 27mm (plus tolerance) over and perpendicular to the target.
	Ensure fiber optic cable is not damaged by checking the spot size for intensity.
	Ensure the target being sensed is not directly over high-frequency fluorescent lighting.
	Targets with glossy surfaces may require positioning the fiber optic cable head at an angle to prevent interference from reflections.
Target is learned but color discrimination is not consistent over time	Ensure target color, shape, and distance to fiber optic LED are consistent. If target surface is textured such as textiles or lumber, ensure that the Average mode is being used. Single operating mode is best used for smooth surfaces such as metal or glass.
	Ensure the proper operating mode is activated. Color only mode is intended for targets with large contrast, i.e., blue vs. red. Color Plus Intensity mode is best for targets with little contrast, i.e., light red vs. medium red. Ensure ambient temperature is within operating temperature and tolerance of the sensor.

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